

## CLAIMS OF THE INVENTION

WE CLAIM:

1. A control system for controlling operation of a pipelined packet processing system having two or more stages, wherein each of the two or more stages may process a different portion of a packet and packets are being sequentially processed in the pipeline processing system, the control system comprising:  
a control word bank having two or more locations, the locations in the control word bank configured to store control words such that each packet is associated with a control word;  
a packet counter having an output, the packet counter output comprising an address to a location in the control word bank;  
a byte counter having an output, the byte counter output comprising an offset in the packet at which processing on the packet is occurring;  
a control module configured to receive the packet counter output, the byte counter output, and access the control word bank to thereby selectively provide data to at least one stage of the pipelined packet processing system to control processing of the packet in the at least one stage.
2. The control system of Claim 1, wherein to control processing of the packet comprises controlling which portions of the packet are processed.

3. The control system of Claim 1, further configured to access control store instructions and wherein the packet counter and the byte counter is associated with each of the two or more stages.

5 4. The control system of Claim 1, wherein the pipeline processing system is configured to add, modify or strip data from a packet.

5. The control system of Claim 1, further including a multiplexer control system comprising multiplexer control logic and multiplexer control instruction memory,  
10 wherein control logic is configured to control operation of one or more multiplexers based on the multiplexer control instructions stored in the multiplexer control instruction memory.

6. The control system of Claim 1, wherein the pipelined processing system is  
15 configured to attach a tag comprised of tag data to the packet, the tag data being obtained from the control word associated with the packet, a label, a control store instruction, any combination of the control word, label, or control store instruction

7. The control system of Claim 1, wherein the control word bank has a write  
20 pointer that is incremented after each write.

8. The control system of Claim 1, further including memory configured to store a label, the label being accessible by the control module.

9. A control system for a packet processing system with multiple stages, each stage receiving a portion of a packet at a time, the control system comprising:

a processing location tracking system configured to generate tracking data regarding which portion of a packet a stage is processing;

a control word storage having two or more storage locations configured to store two or more control words;

control word identification system configured to provide a pointer to a location in the control word storage;

an interface configured to selectively provide tracking data and control word data stored at a location identified by the pointer to a stage.

10. The control system of Claim 9, further including an end of packet monitor configured to reset the processing location tracking system and modify the control word identification system upon detection of an end of a packet.

11. The control system of Claim 9, further including a valid data monitoring system configured to enable operation of a stage if the portion of the packet at a stage is valid data.

12. The control system of Claim 9, further including supplemental data storage in communication with the interface or a stage, the supplemental data storage configured to store supplemental data for use in processing a packet.

5 13. The control system of Claim 9, wherein the tracking system comprises a counter configured to increment with passage of a portion or a part of a portion of a packet and the tracking data comprise an output from the counter.

10 14. The control system of Claim 13, wherein a portion of a packet comprises four bytes of data.

15 15. The control system of Claim 13, wherein a portion of a packet comprises two or more bytes of data and a part of a portion comprises a byte of data.

16 16. The control system of Claim 13, wherein the supplemental data comprises a label for use in generating a tag.

17. The control system of Claim 9, wherein the control word identification system comprises a counter configured to increment upon passage of a packet through a stage.

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18. The control system of Claim 9, wherein a control word comprises data that at least partially controls processing of the packet.
19. The control system of Claim 18, wherein the control word is 144 bytes in size.
20. A method for controlling when a processing module will perform processing as a packet passes through a packet processing pipeline, the method comprising:  
resetting a counter having an counter output upon detection of a new packet received at the processing module;  
incrementing the counter upon passage of portions of the packet;  
comparing a portion of control data associated with the packet to the counter output;  
initiating operation of the processing module if the comparing reveals a match between the portion of the control data and the counter output.
21. The method of Claim 20, wherein the comparing is performed by a hardwired comparator.

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22. The method of Claim 20, wherein the portion of the control data comprises data defining an offset from the start of the packet at which processing on the packet is to occur.

5 23. The method of Claim 20, further including:  
analyzing the packet to determine a packet protocol; and  
selecting control data based on the packet protocol.

10 24. The method of Claim 23, wherein the packet protocol consists of IPv4, DiffServe IPv4, and IPv6.

15 25. The method of Claim 20, wherein the method occurs in a plurality of processing module in a plurality of packet processing pipelines in a packet router.

20 26. The method of Claim 20, further including:  
incrementing a second counter upon receipt of the new packet, the second counter having an output comprising an address to a memory;  
storing the control data in the memory at the address generated by the second counter; and

providing the address to the processing module to thereby direct the processing module to the control data associated with the packet being processed by the processing module.

5 27. A method for controlling tag generation in a dynamic processing module, the tag to be associated with a packet, the method comprising:

storing a control word at an address defined by a control word selector, the control word being associated with a packet;

storing control store instructions in memory;

10 passing portions of a packet through a dynamic processing module;

tracking the passing of portions in relation to an offset from the first portion of the packet;

selectively supplementing the packet by adding data from the control word as the packet passes through the dynamic processing module, the supplementing occurring  
15 at locations in the packet based on the tracking and the control store instructions.

28. The method of Claim 27, wherein the control word selector comprises a counter configured to increment upon receipt of a new packet by the dynamic processing module and the output of the control word selector comprises the address.  
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29. The method of Claim 27, wherein portion comprises a byte.

30. The method of Claim 27, wherein tracking comprises resetting a counter upon receipt of a new packet and incrementing the counter as portions of the packet pass through the dynamic processing module.

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31. The method of Claim 27, wherein the dynamic processing module is implemented in hardware.

32. The method of Claim 27, wherein the tag is an MPLS type tag.

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33. The method of Claim 27, wherein the control store instructions control at what offset from the start of the packet the dynamic processing module will generate tag data.

15 34. A method for selecting between two or more control words when processing a packet at each processing stage as the packet passes through a packet processing pipeline, the method comprising:

receiving the packet at a processing stage in a packet processing pipeline;

modifying the output of a tracking system upon receipt of the packet at the

20 processing stage;



storing a control word at one of two or more locations in a control word bank,  
the one of the two or more locations defined by the output of the tracking system;

providing the tracking system output to the processing stage, wherein the  
tracking system output selects which control word the processing stage will use.

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35. The method of Claim 34, wherein more than one processing stage concurrently  
utilizes the same control word due to the packet being concurrently processed by more  
than one processing stage and the control word comprises between 1 byte and 2048  
bytes of data.

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36. The method of Claim 34, wherein the processing stage comprises a dynamic  
processing module or a static processing module.

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37. The method of Claim 34, wherein the tracking system comprises a counter  
associated with the processing stage, the counter configured to increment upon receipt  
of packet or upon the end of a packet at the processing stage.

38. The method of Claim 34, further including storing associated packets and  
control words prior to entry of a packet into the processing pipeline.

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39. A method for controlling data flow between storage locations in a pipeline processing system, the method comprising:

storing data in a first storage location;

reading control data from a first memory;

5 providing the control data to a data processing stage;

transmitting data from the first storage location to the data processing stage;

processing the data at the data processing stage based on the control data to create processed data; and

10 transmitting the processed data based on the control data to any of a plurality of second storage locations.

40. The method of Claim 39, wherein transmitting the processed data is performed by multiplexer.

15 41. The method of Claim 39, further including:

transmitting the processed data to a second data processing stage;

providing second control data to the second data processing stage;

processing the processed data with the second data processing stage based on the second control instructions.

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42. The method of Claim 39, wherein the first and second storage locations comprise data registers.

43. An apparatus for controlling one or more packet modification systems in a  
5 pipeline processing system comprising:

means for identifying a portion of a packet that is in a modification system;

means for identifying a control word for use by the one or more modifications  
systems, the control word providing data to the one or more modification systems to  
control operation of the one or more modification system;

10 means for storing the control word;

means for interfacing the means for identifying a portion of a packet, means for  
identifying a control word, and means for storing the control word with one or more  
modification systems.

15 44. The apparatus of Claim 43, further including:

means for detecting an end of a packet, said means for detecting used by the  
means for identifying a portion of a packet and the means for identifying a control word  
to account for a new packet.

20 45. The apparatus of Claim 43, wherein the means for identifying a portion of a  
packet and the means for identifying a control word comprises counters.

46. The apparatus of Claim 43, further including means for inhibiting modification system operation when invalid data is in the modification system.

5 47. The apparatus of Claim 43, further including means for storing a label in communication with the interface, the label comprising data for use in tag generation.

48. A control system for a data processing module comprising:  
a first memory location configured to store supplemental data  
10 a second memory location configured to store data selector control data;  
a third memory location configured to store packet data;  
a data selector in communication with the first memory location, the second memory location and the third memory location, the data selector configured to selectively output either packet data or supplemental data based on the data selector  
15 control data.

49. The system of Claim 48, wherein the supplemental data comprises data to be associated with the packet data as a tag.

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50. The system of Claim 48, further including a buffer configured as a first-in, first-out memory location to store packet data and control data, the buffer further configured to provide stored packet data to the data processing module and provide control data to the first memory location.

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51. The system of Claim 48, further including forth memory configured to store additional supplemental data that is communicated to the data selector instead of the supplemental data.

10 52. The system of Claim 48, wherein data selector comprises a multiplexer configured to output packet data and supplement data to thereby generate a modified packet.